In-Situ X-Ray Imaging System for Planetary Science, Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

This project is to study the feasibility of developing an in-situ, compact, low-power, non-destructive X-ray imaging instrument to investigate the ice/rock critical properties, such as *density, porosity, crack, and chemical non–uniformity, liquid distribution and flowing path, etc..*

This proposed system will be built with compact low-power X-ray components and an innovative system configuration. This imaging system would be expected to be less than 10 pounds with a total size as a shoe box. The sample could be either ice or rock. The compact X-ray imaging system has a significant potential to be useful for NASA's New Frontiers and Discovery missions cross most planetary bodies.

The significance of the proposed technical innovation is from three aspects

1. To leverages the rapid progress in X-ray source and X-ray imaging sensor for building a compact and efficient system.
2. To use a hybrid optic system to get multiple monochromatic and polychromatic beams for enhancing the system efficiency and capability in data collection.
3. To combine the beam system with an innovative scan mechanism for yielding the 3D multi-spectral images with rich information about the samples.

Furthermore, this proposed technology could be combined with other instruments, such as the Mars CheMin system, to form a synergy of the dual/triple modality. The process could be: first to perform the non-destructive multi-spectral 3D CT imaging with the samples, and then do the X-ray Diffraction (XRD) and X-ray Fluorescence (XRF) measurements after the samples to be grounded to powder. The synergy will yield a great amount of information, such as density, porosity, crack, phase composition, etc, as well as the chemical compounds, and trace elements etc. of the samples. To gain such information covering a broad range of the fields would significantly help us to expand our knowledge about the solar system and the universe.

Anticipated Benefits

This in-situ X-ray imaging system would investigate the planetary ice/rock critical internal structure properties, such as *density, porosity, crack, and chemical non–uniformity, liquid distribution and flowing path, etc..* It would be a great addition to the current NASA in-situ instruments, such as Mars CheMin system, by first-time providing those critical internal structure information closely related to the formation history of these samples for NASA's New Frontiers and Discovery missions.

This proposed technology also has a great potential for geological survey,

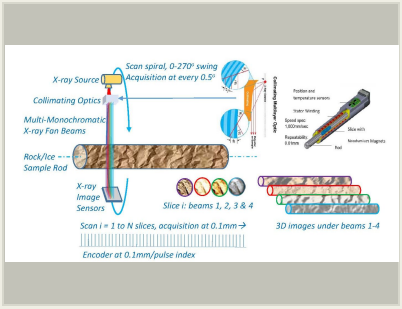

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Table of Contents

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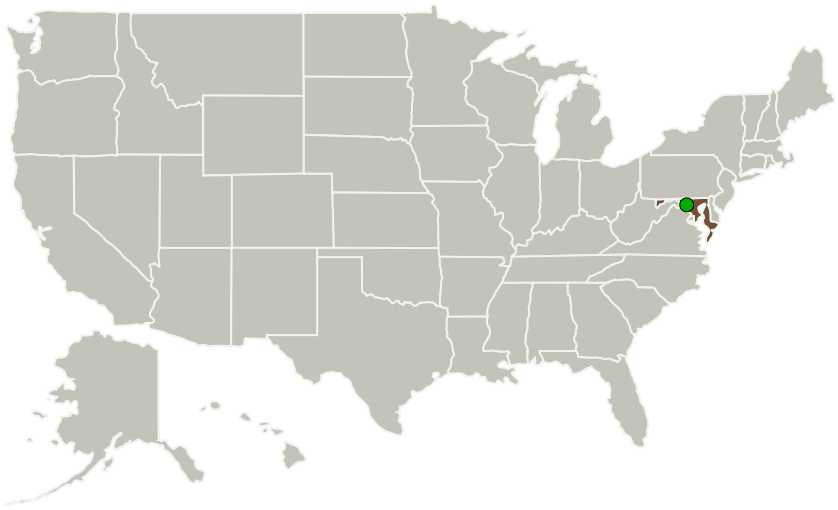
petroleum, and subsurface thermal resource exploration because it can in-situ provide critical internal structure information about the rock/ice samples. For example, it can be utilized in pole areas to investigate the ice samples right on site to avoid the challenges to transfer and reserve the fragile ice samples. This in-situ measurement can improve the efficiency of the survey, exploration, and fundamental research.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Advanced Analyzer Labs, Inc.	Lead Organization	Industry Small Disadvantaged Business (SDB)	Ellicott City, Maryland
Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations
Maryland

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Advanced Analyzer Labs, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

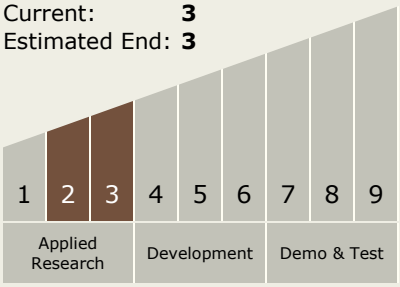
Carlos Torrez

Principal Investigator:

Huapeng Huang

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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Project Transitions

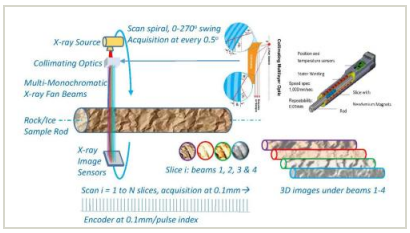
July 2018: Project Start

February 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/141830)*

Images



Briefing Chart Image
In-Situ X-Ray Imaging System for Planetary Science, Phase I *(https://techport.nasa.gov/image/131036)*

Final Summary Chart Image
In-Situ X-Ray Imaging System for Planetary Science, Phase I *(https://techport.nasa.gov/image/125813)*

Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

Target Destinations

The Moon, Others Inside the Solar System